WEAPON SYSTEMS DOMAIN ANNEX

WS.1 DOMAIN OVERVIEW

A Weapon System is a combination of one or more weapons with all related equipment, materials, services, personnel, and means of delivery and deployment (if applicable) required for self-sufficiency (Joint Pub 1-02).

WS.1.1 PURPOSE

This annex identifies standards for the Weapon Systems domain to include information standards and analogous standards applicable to weapon systems.

WS.1.2 BACKGROUND

This Domain Annex follows the JTA core document structure to facilitate the identification and traceability of the Weapon Systems domain additions to the standards mandated in the main body of the JTA. Therefore, the Weapon Systems Domain Annex consists of three sections including: Domain Overview, Mandates, and Emerging Standards.

Weapon Systems mandates result from consensus, concerning the need for the standards and the maturity of their commercial implementations, within the Weapon Systems domain or within the majority of its subdomains.

Currently there are sections within the JTA for which no additions have been mandated in the Weapon Systems Domain Annex or by one or more Subdomain Annexes. However, due to their hard real-time and embedded system requirements, the Weapon Systems subdomains are evaluating the available real-time standards for possible mandate as additions to each section of the JTA, where appropriate.

WS.1.3 DOMAIN DESCRIPTION

Weapon Systems have special attributes (examples: timeliness, embedded nature, space and weight limitation), adverse environmental conditions, and critical requirements (e.g., survivability, low power/weight, and dependable hard real-time processing) that drive system architectures and make system hardware and software highly interdependent and interrelated. The position of the Weapons Systems domain in the Notional JTA Hierarchy is shown in Figure WS-1.

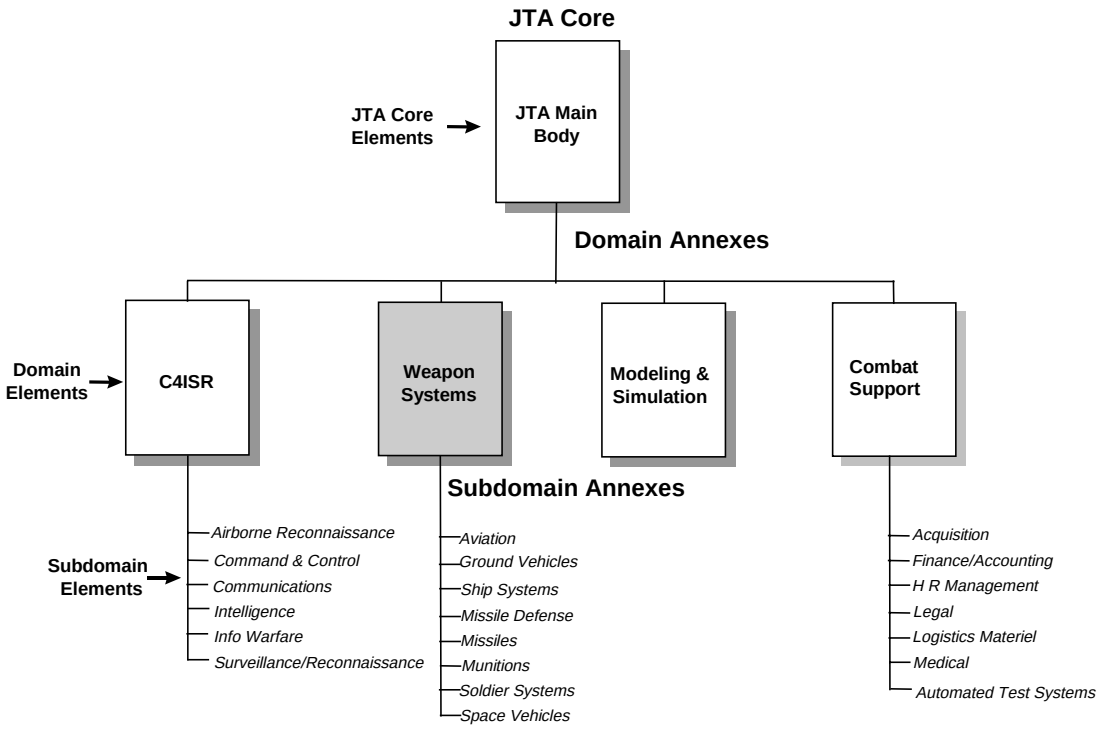


Figure WS-1 Notional JTA Hierarchy

WS.1.4 SCOPE AND APPLICABILITY

A domain is defined as a distinct functional area that can be supported by a family of systems with similar requirements and capabilities. The Weapon Systems Domain Annex, in conjunction with the JTA core, establishes the minimum set of rules governing the application of information technology between weapon systems, where a weapon system is defined as a combination of one or more weapons with all related equipment, materials, services, personnel and means of delivery and deployment (if applicable) required for mission success (Joint Pub 1-02). The Weapon Systems domain encompasses a subset of the JTA, and the specific supporting standards profile. For the purposes of the JTA, the Weapons System Domain is that domain whose systems' primary function is that of supporting attack and/or defense against an adversary,

and that are intentionally designed to interoperate with other weapons systems and/or with systems external to the Weapon Systems domain.

The Weapon Systems Domain annex is applicable to all weapons systems as defined in Joint Pub 1-02.

For the purposes of the JTA, the Weapon Systems domain is organized into subdomains to facilitate the identification of interoperability standards for common areas while maintaining the systems' primary design function of supporting attack and/or defense against an adversary.

The inclusion or exclusion of subdomains in the Weapons System Domain is based upon the Domain participants' agreement to include or exclude a candidate. It is important to note that some weapons systems incorporate features/functions associated with more than one subdomain and therefore must consider the applicable standards from the pertinent subdomains. The current weapon systems subdomains are:

Ground Vehicle subdomain
Includes all DoD weapons systems on moving ground platforms, except missiles, both wheeled and tracked, manned and unmanned.

Aviation subdomain
Includes all DoD weapons systems on aeronautical platforms, except missiles, both manned and unmanned, fixed wing and rotorcraft.

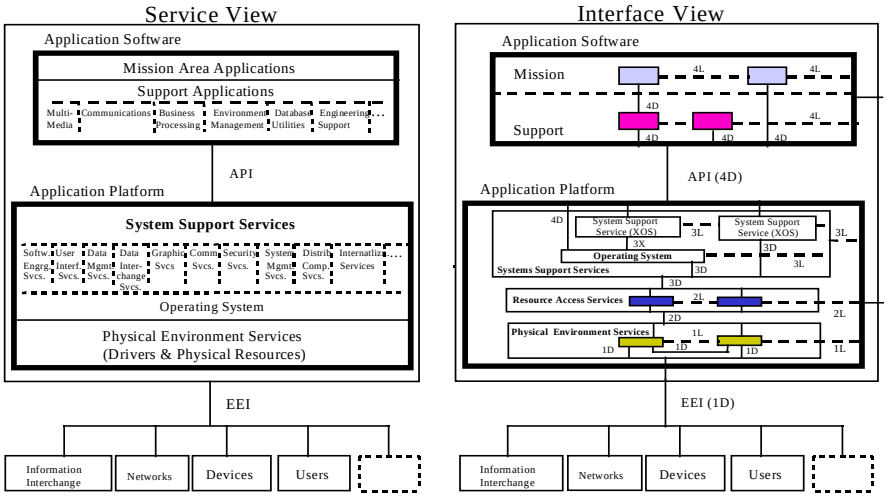
Missile Defense subdomain
Includes any system or subsystem (including associated BM/C4I systems) with a mission to detect, classify, identify, intercept, and destroy or negate the effectiveness of enemy aircraft or missiles before launch or while in flight so as to protect US and coalition forces, people, and geopolitical assets.

WS.1.5 TECHNICAL REFERENCE MODEL

WS.1.5.1 DoD TRM Views

The Weapon Systems domain and subdomains use both the DoD TRM Service View and the Interface View, as described in Section 2. The Interface View is more applicable to real-time systems. Services are best described by the DoD TRM Services View. Interface standardization in weapon systems is a goal of the Open Systems Joint Task Force (OSJTF) of DoD. Both views are needed to capture all of the standards required for the Weapon Systems domain and subdomains to operate within the DoD Enterprise.

Figure WS-2 depicts the DoD TRM Service View and Interface View. The Interface View is based on the GOA framework. Both views were developed using the POSIX model as a baseline. The POSIX Applications Software Layer is analogous to the Application Software Interface View, while the Service View extends the POSIX model by categorizing Application Software into mission area applications and several support application areas.



Integrated DoD Technical Reference Model

Figure WS-2 DOD TRM Service View and Interface View

The Interface View expanded the Application Platform entity within the POSIX model to include the three other layers: Systems Support Services, Resource Access Services, and Physical Environment Services. The Interface View includes the 4L, 3L, and 2L, for peer-to-peer logical interfaces, and the 3X, 3D, and 2D direct interfaces. The Application Programmers Interface (API) is synonymous with the 4D interface. The External Environment Interface (EEI) is synonymous with the 1L and 1D interfaces treated as a pair. Thus the Interface View extends the Service View by including language describing application-to-application logical interfaces, expanding the Application Platform, and by including language to discuss Application Platform-to-Application Platform logical interface (3L and 2L interfaces).

The Service View, unlike the Interface View, categorizes services available in the Applications Platform. The Application Platform service areas defined by the Service View include both run-time and pre-run-time services. The Service View addresses only 4D API interfaces and 1D/1L EEI interfaces. The Service View does not address 2L, 3L, or 4L peer-to-peer logical interfaces, 3X, 3D, or 2D direct interfaces, nor does it address Resource Access Services.

The Interface View contains two types of interfaces: logical and direct. A logical interface defines requirements for peer-to-peer interchange of data. It identifies senders, receivers, data types, frequency of exchange, and formats. A direct interface identifies the characteristics of the information transfer medium. Simply stated, logical interfaces define what information is transferred, the direct interfaces define how the information is transferred. Logical interfaces are implemented with direct interfaces.

Section WS.2 uses the Service View and identifies additions to the JTA core standards. WS.2 also includes emerging standards representing current standards work within the Weapon Systems domain.
The DoD TRM Interface View is based on the SAE GOA framework, and provides a framework to identify interface classes for applying open system interface standards to the design of hardware/software systems. As a result, the following architecture standard is used to define the interfaces:

– SAE AS 4893. Generic Open Architecture (GOA) Framework, 1 January 1996.

WS.1.5.1.1 Performance Environment

One of the most distinctive features of a weapon system is the importance of performance characteristics. Weapon systems are developed to meet stringent operational performance criteria in order to be accurate

and lethal; and to survive. In order to emphasize this issue, performance is modeled as a separate external environment entity. At the lower level of TRMs, performance will be an integral part of the services.

WS.1.5.1.2 Application Hardware Environment

Within weapon systems, embedded computing hardware and software components are highly interdependent in order to satisfy very demanding requirements. The DoD TRM Service View often does not fit a general purpose computing model very well. Therefore the DoD TRM Interface View is used to capture such features as interconnect and open systems hardware standards.

WS.1.5.2 Hierarchy of TRM Views

In order to capture the diversity found in weapon subsystem design, a hierarchical approach to TRM Views is being established. From the DoD TRM Service View in Figure WS-2, the DoD TRM Interface View in Figure 2.1-2 will extend downward into the Weapon Systems domain and subdomains to provide the basis for standards identification and traceability.

WS.1.6 ANNEX ORGANIZATION

This annex is divided into three sections: the Overview in Section WS.1, the Additions to the JTA Core Service Areas in Section WS.2, and the Domain Specific Services in Section WS.3. Section WS.2 follows the JTA Section 2 service area structure. The structure of Section WS.3 will evolve as WS-specific service areas are identified and a common structure is coordinated amongst the other annexes.

WS.2 ADDITIONS TO THE JTA CORE

WS.2.1 INTRODUCTION

The DoD TRM Interface View provides for sufficient fidelity to identify critical functions, interfaces, and technical issues.

WS.2.2 INFORMATION PROCESSING STANDARDS

This section applies to mission area, support application, and application platform service software developed or procured to process information for weapon systems.

WS.2.2.1 Mandate Additions

There are no additions mandated for the Information Processing Standards section.

WS.2.2.2 Emerging Standards

WS.2.2.2.1 Emerging General Standards

There are no emerging general standards for the Information Processing Standards section.

WS.2.2.2.2 Emerging Service Area Standards

WS.2.2.2.2.1 Operating System Services

The OSJTF is sponsoring and synchronizing Weapon Systems domain involvement in the IEEE POSIX working groups. Many POSIX standards are at various stages of standardization and are expected to be revised shortly to accommodate real-time systems' requirements and to provide for test methods. The following standards are emerging:

– IEEE P1003.5c/D3 POSIX-Part 1: Binding for API - Amendment 2: Protocol Independent Interfaces, October 1997.
– IEEE P1003.5f POSIX: Ada binding to 1003.21, January 1997.
– IEEE P1003.1e/D15 POSIX: Protection Audit And Control Interface (C Language), December 1995.
– IEEE P1003.22/D6. POSIX-Open System Security Framework, August 95.

WS.2.2.2.2.2 Real-time Common Object Request Broker Architecture (CORBA)

Real-time Common Object Request Broker Architecture (CORBA) - The OMG Special Interest Group is evaluating the need for real-time object oriented standards and products to support real-time embedded systems. As more information becomes available from this group the Weapon Systems domain will consider adopting the standards as additions to the JTA information processing standards.

WS.2.3 INFORMATION TRANSFER STANDARDS

There are no additions mandated for the Information Transfer Standards section.

WS.2.4 INFORMATION MODELING, METADATA, AND INFORMATION EXCHANGE STANDARDS

This section fosters information exchange among Weapon Systems during their development and maintenance phases. During concept exploration and development a large number of information elements, objects, and artifacts are generated. If these elements, objects, and artifacts are shared across weapon system developments, considerable resources can be saved.

Real-time, embedded processing systems must be developed within a development support environment for an entire system. As such, they must integrate into a systems engineering process that culminates in prototype or production weapon systems that meet specific functional and performance requirements.

WS.2.4.1 Emerging Standards

The following emerging standard is being considered for mandate by the Weapon Systems domain as an addition to the JTA information modeling standards:

– IEEE 1076: 1993, Standard VHSIC Hardware Description Language (VHDL) Reference Manual, 1993. (VHDL is a high level hardware language).

Additional emerging standards are:

– IEEE 1076.2: VHDL Mathematical Package, 1996.
– IEEE 1076.3: Standard VHDL Synthesis Packages, 1997.
– IEEE 1076.4: VITAL Application-Specific Integrated Circuit (ASIC) Modeling Specification, 1995. (Provides VITAL timing and primitives).

WS.2.5 HUMAN-COMPUTER INTERFACE STANDARDS

This section provides a common framework for Human-Computer Interfaces (HCI) design and implementation in weapon systems. It complements and extends the DoD HCI Style Guide, Version 2.0, 10 October, 1997. The objective is to standardize user interface design and implementation options across weapon systems, thus enabling applications within the Weapon Systems domain to appear and behave consistently, resulting in higher productivity, shorter training time, and reduced development, operation,

and support costs besides influencing commercial HCI development. This version mandates the design of graphical and character-based displays and controls for weapon systems.

In order to identify appropriate systems to use for baseline characterization, the following working definition for time criticality is used: *"Systems where no perceptible delay exists between the time an event occurs and the time it is presented to the user; and where there is an operational requirement for the user to quickly recognize this presentation, comprehend its significance, and determine and execute appropriate action(s)."*

There are some aspects of HCI's that can be common across the Weapon Systems domain, while others are subdomain specific. Hence, an HCI style guide is required at the weapon systems level, and currently for each subdomain.

WS.2.5.1 Additions

There are no additional mandates for the Human-Computer Interface Standards section.

WS.2.5.2 Emerging Standards

The Weapon Systems Human-Computer Interface (WSHCI) Style Guide addresses guidelines that are applicable across most or all of the Weapon Systems domain. It provides a starting point for the development of the subdomain-specific style guides that will further the goal of standardization. Also, the WSHCI Style Guide provides design guidance based on lessons learned and best practices from past HCI efforts. However, the WSHCI Style Guide does not provide the level of design guidance needed to attain a common behavior and appearance. This is left to the subdomain-specific style guides. The following army document is proposed as the starting point to become the joint weapons system style guide:

– U.S. Army Weapon Systems Human-Computer Interface (WSHCI) Style Guide, Version 1.0, 30 September 1996.

WS.2.6 INFORMATION SYSTEMS SECURITY STANDARDS

There are no additions mandated for the Information Systems Security Standards section.

WS.3 DOMAIN SPECIFIC SERVICE AREAS

WS.3.1 APPLICATION SYSTEMS HARDWARE STANDARDS

The primary purpose of this section is to minimize the percentage of standalone and closed application modules used in Weapon Systems. The secondary purpose is to foster the development of commercial hardware standards that can be used for Weapon Systems development.

Real-time embedded processing systems must control, sense, and integrate with an application hardware environment. The application hardware is generally a custom built electronic or mechanical module. The application hardware along with the processing system and application software must work together to perform unique mission requirements. The level of coupling of the processing system to the application hardware environment determines the possibility of modular partitioning.

WS.3.1.1 Additions

There are no additional standards mandated for the Application Hardware section.

WS.3.1.2 Emerging Standards

There are no emerging standards in this section.

WS.3.2 EMERGING EMBEDDED COMPUTING STANDARDS

There are no emerging embedded computing standards in this version of the Weapon Systems Annex.